SNPLMA Project #: _____ **(To be assigned by SNPLMA Administration)**

TAHOE PROJECT PROPOSAL

Project Name: Effects of Fire and Long-term Fire Suppression on Tahoe Basin Water Quality	**EIP #:** 10123
Lead Agency: USFS LTBMU	**Contact:** W.W. Miller (UNR) D.W. Johnson (UNR) and S. Norman (LTBMU)
Sponsoring Agency: USFS LTBMU	**Phone Number:** 775-784-4072 or -4511, UNR; 503-543-2662, LTBMU
Threshold: Water Quality, Vegetation	**Email Address:** wilymalr@cabnr.unr.edu dwj@unr.edu snorman@fs.fed.us
Threshold Standard: WQ4-Streams	**First Year Funding Request:** $200,000 (*total 3-Year Project Cost: $638,419*)
Project Description: W.W. Miller and D.W. Johnson, PIs; P. Weisberg and R.F. Walker, Co-PIs.	

Our current study was designed to investigate the effects of fuel reduction management using prescribed fire and mechanical harvest on surface and subsurface discharge water quality, soil nutrient status, vegetation growth, forest health, and nutrient budgets (C, N, P, and S). A serendipitous wildfire at the South Tahoe site (Gondola) afforded us an unprecedented opportunity to assess the effects of wildfire due to the fact that we had plots in place and had taken pre-fire measurements. We propose to build on the present study by investigating the impacts of both fire and long-term fire suppression on water quality and ecosystem response. Water quality measurements will include a water balance, soil solution, surface runoff and tributary measurements. In addition, we will sample soils and vegetation in mature forests subjected to long-term fire suppression, areas of post-wildfire recovery, following prescribed burns, and adjacent unburned areas so that carbon and nutrient budgets can be constructed. Results will be extrapolated in time and space using a combination of simulation modeling and assessment of historic fire regimes common to the region. This approach will allow us to assess the effects of fire, and hence fire suppression, on discharge water quality, soil fertility, and the health of the re-growing forest. In so doing, it is our intent to provide a substantial contribution to the body of information necessary for developing sound adaptive management strategies specific to the forests of the eastern Sierra Nevada.

Describe the purpose and need for the project:

Findings from our current study strongly suggest that the heavy buildup of forest floor litter in mature forests due to fire suppression may actually have increased nutrient discharges from watersheds of the Tahoe Basin. Specifically, we find that leachates from the forest litter layer are very high in ammonium, nitrate, and ortho-P concentrations. We hypothesize that allowing buildup of the forest litter layer (by fire suppression) has worsened water quality because it has increased the source of these nutrients. Hence, natural sources of nutrient laden water from forest litter may be a significant contributor to the decline in Lake Tahoe water clarity. To test this new hypothesis, more comprehensive information is needed to develop benchmarks for pre-settlement fire regimes that can be used to guide prescribed fire and stand density restoration treatments, and assess how long-term fire suppression may have adversely affected nutrient cycling processes in upland Sierran watersheds. Furthermore, there is a particular need for extensive, spatially explicit fire history sampling to describe variation in fire regime history across landscape scales. Finally, little is known regarding the direct effects of post fire re-

established N-fixing vegetation (snowbush, alder) on discharge water quality. These species are stimulated by large-scale disturbances such as wildfire, but are typically suppressed by alternate fire mitigation strategies. Such aspects can be explored using an experimental framework that samples from recent and historic fire sites, and areas subject to current forest management practices.

Describe the goals and objectives of the project (For Science & Research Projects describe Key Management Questions being addressed):

The overriding goal of this research is to formulate an adaptive management strategy for improving water quality in the Lake Tahoe basin and eastern Sierra Nevada that incorporates the protection and effective management of critical watershed values. Our specific objectives are: (KMQ: 1.1.1, 1.1.3, 1.1.4, 1.1.12, 2.1.2, 2.1.4, 2.1.13, 2.4.3)

1) To temporally and spatially reconstruct the fire history for a network of study plots arranged to span a gradient of topoclimatic and edaphic variation;
2) To thereon assess the effects of historic fire regime, wildfire, and fire mitigation on temporal and spatial water balance components affecting nutrient transport;
3) To thereon evaluate the effects of historic fire regime, wildfire, and fire mitigation on soil and biomass nutrient status, cycling, and input/output budgets;
4) To calibrate and test two models for the estimation of historic fire regime, wildfire, and fire mitigation impacts on nutrient cycling and discharge water quality from sub-alpine watersheds of the Lake Tahoe basin and similar ecosystems elsewhere; and
5) To assess at appropriate spatial scales the effects of wildfire and fire management practices in the Tahoe basin.

(Objective 1) Fire history will be re-constructed from fire scars for a network of 1-ha fire history plots, spanning a gradient of topoclimatic and edaphic variation. Two forms of sampling will be performed; targeted and random. Standing trees will be sampled using increment cores and partial cross-sections from scarred “catfaces”. Cut stumps will be sampled using partial or full cross-sections. A master fire chronology will be constructed, summarizing the occurrence of historical fires at each of the sampled sites. Spatial variation in fire frequency, severity, extent and seasonality across the sampled environmental gradient will be analyzed statistically within a GIS context, using generalized linear models to determine topoclimatic and edaphic influences. Temporal variation in fire regime parameters will be assessed according to both anthropogenic influences (e.g. fire suppression) and climatic variation.

(Objectives 2 and 3) Nutrient resin and suction lysimeters, rain gages, runoff and snowmelt collectors will be installed at each site for the assessment of water quality and water balance parameters. Soil solution, rainfall, snowmelt, surface runoff, and adjacent streamflow will be analyzed for ammonium, nitrate, ortho-phosphate and sulfate. Inventories of forest floor duff and litter, coarse woody debris, herbaceous vegetation, shrubs, and understory conifers will also be conducted including standard mensuration measurements, soil and vegetation sampling for nutrient analysis. Soils will be analyzed for pH, total C, total and extractable N, P and S, exchangeable Ca, K, Mg, and Na, and cation exchange capacity. Vegetation and litter samples will be analyzed for total N, P, K, Ca, Mg, and S.

(Objective 4) Nutrient data will be used to calibrate and test two models for the purpose of extrapolation on a regional scale; NuCM and NuCSS. NuCM is a complicated ecosystem model that has traditionally been applied to a number of forest manipulations directly applicable to fire simulation, and NuCSS is a simple spreadsheet hybrid model used to simulate the effects of prescribed fire on nutrient balance interactions.

(Objective 5) Fire history will be related to contemporary patterns of forest age structure, tree

species composition, forest floor biomass, nutrient cycling and discharge water quality. Cluster analysis will be used to group sampled stands of similar characteristics. These groups will be analyzed according to spatial pattern, historical fire regime, and ecosystem response. The results from this analysis will help us to understand where in the landscape changes as the result of fire or fire suppression have been most dramatic.

Describe the anticipated project accomplishments:
October 2004 through May 2005: Recruitment of field technician and PhD graduate students. Literature review, project study site delineation, and formalized work schedule.
June through September 2005: Develop forest and litter inventories, soil and vegetative sampling, fire history sampling, and equipment installation. Collection of water quality, soil fertility, vegetation, forest health, and water balance parameter data.
October 2005 through May 2006: Sample preparation, analysis, and interpretive assessment. Begin construction of master fire chronology. Calibrate and test NuCM and NuCSS models. Over-winter monitoring of soil solution, surface runoff, and snowmelt.
June through September 2006: Maintenance and re-installation of field equipment for continued collection of field data. Finalize master fire chronology, apply GIS data layer for fire history, reconstruction of fire history maps, preparation of interpretive summaries for fire history, forest health, nutrient cycling, and discharge water quality interactions.
October 2006 through May 2007: Sample preparation, analysis, and interpretive assessment. Statistical characterization of fire regime, ecosystem response, nutrient discharge, and water quality impacts. Preparation for publication and dissemination.
June through September 2007: Continued monitoring and data collection, GIS extrapolation and predictive mapping of fire regime (frequency, severity, seasonality, suppression) and ecosystem response parameters (plant succession, mortality, density, nutrient cycling, discharge water quality) for utilizing historical fire patterns as a management tool for targeted restoration, or for creating spatial patterns of desired forest structure. Publication and preparation of a final report summarizing how spatial patterns of historical fire regime, how fire regime has changed subsequent to fire suppression, how temporal and management changes have impacted ecosystems response, and how ecosystem response has impacted Tahoe Basin water quality.

Describe the "readiness" of this project to move forward (Environmental documentation, etc.).
Collaborative projects are in-place, no further environmental documentation is required.

Describe partnerships/linkages for this project. (Include documentation)
The proposed research is consistent with the long-term goals and objectives of the USFS Joint Fire Sciences Program;
Water balance parameters will be developed in collaboration with the multi-state research project entitled "Characterizing mass and energy transport processes at different scales (W-188)";
Findings will directly link to collaborative studies assessing the impact of wildfire and fire mitigation activities on wildlife and vegetation richness and diversity.

For Science & Research Projects describe how this project will guide future management activities:
Findings will be directly pertinent to hydrologic and nutrient transport models used to estimate the ecological impacts of fire and water quality management strategies in the Lake Tahoe Basin. Data will directly apply to forest management efforts as they pertain to several Basin thresholds.

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Include an 8 ½ X 11 map depicting the project, or research/study area.

The potential area for study site selection encompasses the entire Lake Tahoe Basin Watershed.

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TAHOE SCIENCE AND RESEARCH PROJECTS
ESTIMATED DIRECT COSTS & KEY MILESTONE DATES

Project Name: Effects of Fire and Long-term Fire Suppression on Tahoe Basin Water Quality	**Sponsoring Agency:** U.S. Forest Service LTBMU	**Date:** March 10, 2004
Contacts: W.W. Miller and D.W. Johnson - UNR, S. Norman - LTBMU	**Phone:** 775-784-4072 or -4511, UNR 503-543-2662, LTBMU	**EIP #** 10123

Identify estimated costs of eligible reimbursement expenses:

1. Planning and Research Costs (Specialist surveys, reports, monitoring, data collection, analysis, etc.) USFS – LTBMU participation	$ 110,000	17.2 %
2. Direct Project Labor (Payroll, fringe benefits, etc.)	$ 0	0.0 %
3. Equipment (tools, software, specialized equipment,etc.)	$ 10,000	1.6 %
4. Travel (Travel expenses associated with project)	$ 0	0.0 %
5. Project Contracts, Grants and Agreements (Contracts, grants, agreements to be awarded) University of Nevada – Reno participation	$ 488,419	76.5 %
6. Project Administration (contract admin services, procurement costs, etc.)	$ 30,000	4.7 %
7. Other (Explain)	$ 0	0.0 %
8. Contingency Reserve (Not to exceed 10%)	$ 0	0.0 %
PROJECT TOTAL:	*$ 638,419*	*100.0 %*
FIRST YEAR FUNDING REQUEST:	$200,000	(Phase I) 100.0 %

Estimated Key Milestone Dates:

Milestones:	Date:	Estimated Costs
Phase I - FY05 Project Annual Report	Dec. 15, 2005	$ 200,000
Phase II - FY06 Project Annual Report	*Dec. 15, 2006*	*$ 212,640*
Phase III - FY07 Project Annual Report	*Dec. 15, 2007*	*$ 215,779*
Final Completion Report (incl USFS review)	*Apr. 15, 2008*	*$ 10,000*

COMMENTS:
Funding for Phase II and Phase III will be requested in FY05 and FY06, respectively.